

Chapter 37 Circulatory and Respiratory Systems**Summary****37-1 The Circulatory System**

The human circulatory system consists of the heart, blood vessels, and blood. Together with the respiratory system, the circulatory system supplies the body's cells with nutrients and oxygen and removes carbon dioxide and other wastes from the body.

The heart is located near the center of the chest. It is composed almost entirely of muscle. The thick layer of muscle that forms the walls of the heart is called the myocardium. Contractions of the myocardium pump blood through the circulatory system.

The heart is divided into right and left halves by a wall called the septum. Each half of the heart has two chambers, for a total of four chambers. The upper two chambers, or atria (singular: atrium), receive blood entering the heart. The lower two chambers, or ventricles, pump blood out of the heart. The right side of the heart pumps blood from the heart to the lungs. This pathway is the pulmonary circulation. The left side of the heart pumps blood to the rest of the body. This pathway is the systemic circulation. Flaps of connective tissue, called valves, between chambers prevent blood from flowing backward in the heart.

Each heart contraction begins in a small group of cardiac muscle cells called the pacemaker. From the pacemaker, the impulse travels through the rest of the heart, causing the heart to contract.

When blood leaves the heart for the body, it passes into a large blood vessel called the aorta. As blood flows through the rest of the circulatory system, it moves through three types of vessels: arteries, capillaries, and veins. Arteries are large vessels that carry blood away from the heart.

From arteries, blood flows into capillaries, the smallest vessels. Capillaries bring nutrients and oxygen to the cells and absorb carbon dioxide and other wastes. From the capillaries, blood flows into veins and is returned to the heart. Large veins contain valves that keep blood moving toward the heart.

The pumping of the heart produces pressure. The force of the blood on artery walls is called blood pressure. Blood pressure keeps blood flowing through the body. Blood pressure is controlled by the autonomic nervous system and the kidneys.

Diseases of the circulatory system, called cardiovascular diseases, are leading causes of death. Two causes of these diseases are high blood pressure and atherosclerosis, in which fatty deposits build up in arteries. Both high blood pressure and atherosclerosis force the heart to work harder and can lead to heart attack and stroke. Cardiovascular diseases are easier to prevent than cure. Prevention includes exercising regularly, eating a low-fat diet, controlling weight, and not smoking.

37-2 Blood and the Lymphatic System

Blood is a type of connective tissue containing dissolved substances and specialized cells. Blood is almost half cells and just over half fluid. The fluid portion of blood is called plasma. Plasma is mostly water. Proteins in plasma help to clot blood and fight infections.

Cells in blood include red blood cells, white blood cells, and platelets. Red blood cells transport oxygen. A protein called hemoglobin in red blood cells binds to

oxygen and carries it throughout the body. White blood cells guard against infection, fight parasites, and attack bacteria. There are many types of white blood cells. White blood cells known as lymphocytes produce antibodies. Antibodies are proteins that help fight infection. Platelets—along with plasma proteins—make blood clotting possible. Platelets cluster around a wound and release proteins called clotting factors, leading to the formation of a clot.

As blood circulates, some fluid leaks from the blood into surrounding tissues. This fluid is called lymph. The lymphatic system consists of a network of vessels, lymph nodes, and organs. This system collects lymph and returns it to the circulatory system. The lymphatic system also helps absorb nutrients and fight infection.

37–3 The Respiratory System

In biology, the word *respiration* is used in two ways. Cellular respiration, as you may recall, is the release of energy from the breakdown of food molecules in the presence of oxygen. The other meaning of respiration is the exchange of gases between an organism and the environment. The human respiratory system brings about the exchange of oxygen and carbon dioxide between the blood, the air, and tissues.

The respiratory system consists of the nose, pharynx, larynx, trachea, bronchi, and lungs. Air from the nose enters the pharynx, a tube in the throat. Air moves from the pharynx into the trachea. At the top of the trachea is the larynx, which contains the vocal cords. From the trachea, air passes into two large passageways in the chest called bronchi (singular: bronchus). Each bronchus leads into one of the lungs. Within each lung, the bronchus subdivides into smaller passageways, called bronchioles. The bronchioles continue to subdivide until they reach millions of tiny air sacs called

alveoli (singular: alveolus). Each alveolus is surrounded by capillaries. Oxygen crosses the thin capillary walls from the alveolus into the blood. Carbon dioxide in the blood crosses in the opposite direction into the alveolus.

Breathing is the movement of air into and out of the lungs. At the bottom of the chest cavity is a muscle called the diaphragm. When the diaphragm contracts, the chest cavity becomes larger. This creates a partial vacuum in the chest. Air pressure causes air to rush in and fill the lungs. When the diaphragm relaxes, the chest cavity becomes smaller. Increased pressure inside the chest forces air back out of the lungs.

The rate of breathing is controlled by the level of carbon dioxide in the blood. This level is monitored by the medulla oblongata in the brain. As the carbon dioxide level rises, the medulla oblongata sends nerve impulses to the diaphragm, causing it to contract. This results in breathing.

Tobacco smoke harms the respiratory system. Three of the most dangerous substances in tobacco smoke are nicotine, carbon monoxide, and tar. Nicotine is a stimulant that increases heart rate and blood pressure. Carbon monoxide is a poisonous gas that blocks the transport of oxygen by blood. Tar contains substances that cause cancer. Smoking can cause emphysema, which is loss of elasticity in the tissues of the lungs. Smoking can also cause lung cancer and heart disease. Passive smoking means inhaling the smoke of others. Passive smoking is damaging to nonsmokers, especially young children. Quitting smoking can improve a smoker's health. The best solution, however, is not to begin smoking.